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THE SIGNAL SERVICES IN THE SERVICE OF OKH

DURING WORLD WAR II

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Entering the I Bavarian Telegraph Bn, Munich, as officer candidate in 1913, Albert PRAUN served as chief signal officer at battalion and division level during World War I and remained in Germany's postwar Army after 1918. During the inter-World War period he continued in the signal service and in 1939 was promoted Oberst and assigned to the Seventh Army, operating on the West front, as Chief Signal Officer.

During World War II, PRAUN held numerous assignments as commander at regiment, brigade and division level as well as chief signal officer at army and army group level in France and Russia. In 1942 he was promoted Generalmajor, in 1943 Generalleutnant and in 1944 General der Nachrichtentruppen, being appointed Chief of Army Signal Affairs in OKH and Chief of Armed Forces Signal Communications in OKW on 13 August 1944. This post he retained until captured at Rheims on 15 May 1945.

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I. Historical Review

At the beginning of World War I the German telegraph troops were unable to provide the Army High Command with the necessary technical signal connections for establishing rapid and reliable communication between Chief Headquarters and the armies. There was a lack of practical telephone and wireless communications not only between the western and eastern fronts, but especially to and between the armies of the important right army wing in the West. This was one of the reasons for the failure of the Marne campaign in 1914. The young technical arm did not yet possess the confidence and understanding of the General Staff and the command. The CHIEF OF THE FIELD TELEGRAPH SYSTEM was not informed of strategic intentions. He had no detailed knowledge of the direction, point of main effort and course of operations, nor of the location of headquarters. He belonged to the second echelon, which was situated a long distance away from the Army High Command. Since he was not informed of the plans of the High Command in 1914 until it was too late, he was unable to adapt the signal communications system and the personnel and matériel required for it to strategic requirements in advance. Thus the telegraph troops did not even accomplish what might have been obtained from them at that time in spite of their defective organization and equipment. The basic rule in the service manual that the signal units were supposed to establish communication from subordinate to superior headquarters was false. Not only were the strategic communications unsatisfactory, but also the tactical communication system of the lower command, as well as communications between the service arms during the rapid movements of the first months of the war. After operations had become stalemated in a war of position, energetic individuals completely reorganized the telegraph troops during the following long years of the war with due consideration for their acknowledged defects. They created appropriate units for the higher command and assimilated the inventions of applied science. Numerous new signal devices and improved equipment brought headquarters and troops closer together and shortened the distance between the service arms. Thus it came about that toward the end of the war, despite the extension of the theaters of war, the constantly increasing distances were spanned with more and more efficiency. RADIO INTELLIGENCE, which was unknown before the war and improvised at the beginning of the war, was systematically expanded. It provided the command with strategic and tactical information about the enemy which was of the highest value, especially in the East.

The successes of the Chief of the Field Telegraph System and his troops in establishing communications and procuring information about the enemy strengthened his position at Chief Headquarters, as well as the reputation and importance of his units. He and all Signal Corps commanders serving with the higher and intermediate command, were now informed of the intentions of the command in good time and were assigned their proper duties, so that they could work with an eye to the future.

The technical problems of adequate permanent communications systems for strategic and tactical purposes during movements, of telephone connections over long distances, of the use of multiple-channel telephone cables and of wireless transmission without interference still remained unsolved.

Between the two world wars the activity of the Signal Corps in the 100,000-man army was restricted in accordance with the provisions of the Versailles Treaty to communications within divisions. The signal battalions were subordinate to their respective division commanders. The inspectorate of the Signal Corps, which like the other arms inspectorates was subordinate to the General Army Office, was concerned with the central organization, training and equipment of the Signal Corps. The inspector of the Signal Corps, who was personally subordinate to the Chief of the Army Command, had the right to carry out inspections.

With the increases in the Army undertaken after 1935, corps signal battalions, as well as a few companies, were activated as cadres for the signal units of the higher headquarters. The technical progress made in the meantime brought several of the above-mentioned problems closer to a solution.

After the complete failure of the radio equipment around 1926, some of which were regular commercial models, increasingly efficient equipment was produced for wireless communications. Small portable radio nets improved communications between infantry and artillery, as well as communications between the observers and the firing positions of all heavy weapons. The introduction of undamped long, medium and short-wave radio sets instead of the old, damped, long-wave radio sets, which were sensitive to interference, improved all wireless communications. As a result of the motorization of signal units and their training in transmitting radio messages from moving vehicles, and finally the introduction of ultra short-wave equipment for ARMORED RADIO COMMUNICATION, it was possible to maintain uninterrupted strategic and tactical control of armored units while they were engaged in any form of movement; indeed, this control became simpler, more flexible and more reliable than the control of non-mechanized units.

After Field Telephone Model No 33 proved a failure during the command-post exercises for officers and signal units in 1935 due to the problem presented by the microphone and coll and the sensitivity to moisture of the old portable switchboard, these difficulties and the necessity of telegraphic communication were recognized and by the beginning of the war the forms had been eliminated. The most notable improvement in telephone communication before World War II was the introduction of the four-wire field trunk cable, which was adopted as a trunk circuit in the sector of the infantry divisions or motorized units. This simultaneously created several telephone and teletype circuits with a considerably greater range than the old one-wire field cable. Training experience with the establishment of strategic wire communications was still unsatisfactory. The military use of amplifiers and equipment for multiple-channel communication by overhead lines was still in its beginnings. Since wartime conditions prevented the use of long-distance trunk cables, the Signal Corps continued to work with the crude "permanent field telephone line" with four or eight wires, without being able to eliminate its induction defects sufficiently because of the necessity for rapid installation. Thus, the problem of long-range communication by military means beyond a distance of 1000 kilometers was still unsolved.

The intercept companies attached to the signal battalions monitored what radio traffic they could pick up from neighboring countries. The listening equipment of these units, especially their receivers and position-finders, which were likewise regular commercial models, were at first not efficient enough. By the beginning of the war they had been perfected. The Cryptographic Office (Chiffrierstelle) in the Ministry of National Defense solved codes and ciphers without itself developing any safe cryptographic systems.

The position of the INSPECTOR OF THE SIGNAL CORPS had remained substantially the same as in the 100,000-man army. In questions connected with strategic planning he co-operated with the Army General Staff. The National Defense Decree of 1936 offered him an opportunity to carry out a plan, in which he received strong support from the Air Force, by which the long-range telephone cable system of the German

Post Office, which was organized from an economic point of view and militarily weak, was enlarged and perfected by greatly increasing its circuits and extending many thousands of kilometers of line into areas which had previously had poor communication, so that with its systematically distributed repeater offices it finally offered a reliable foundation everywhere for all kinds of wire communications which would be necessary in the event of war.

II. The Chief of Army Signal Communications as an Organ of the Supreme Army Command in World War II

With the announcement of mobilization the Inspector of the Signal Corps (see Appendix 1) left his position of subordination to the General Army Office and was transferred with his staff to the Army General Staff as CHIEF OF ARMY SIGNAL COMMUNICATIONS with a branch of his own. In general his duties were the establishment, maintenance and operation of the signal communications network of the Army and the observation of enemy signal traffic. In detail, he was responsible for communication between the Supreme Army High Command and the army groups by means of technical signal devices. For this purpose the OPERATIONAL SIGNAL TROOPS (Fuehrungsnachrichtentruppe) were placed directly under him. With respect to the other signal troops, he was responsible for providing them with uniform training and service manuals. He had the right to make inspections and exert influence on the selection of personnel, on organization and equipment, as well as on the technical development and supplying of signal devices. He issued general training instructions to the communication units of the field forces and made sure that they were supplied with signal equipment. Finally, he was responsible for directing the signal intelligence work of his own signal intelligence units and the army groups and for compiling their results for the Army High Command.

The STAFF OF THE CHIEF OF ARMY SIGNAL COMMUNICATIONS (See Appendix 2) was organized in accordance with these duties. It was small and flexible, since most of the more comprehensive tasks which required a lot of personnel were handled by the groups (Amtsgruppen) in Berlin. The essential features of this simple organization were retained throughout the entire war. After the French campaign it was joined by the Railway Signal Communications Section, which took over the work of handling the communications of the CHIEF OF TRANSPORTATION. The most important change was that the CONTROL STATION FOR SIGNAL INTELLIGENCE was separated from the staff in 1944 and attached to the newly created office of the GENERAL OF SIGNAL INTELLIGENCE. Its duties will be mentioned later. The other changes made in the structure of the staff of the CHIEF OF ARMY SIGNAL COMMUNICATIONS in the course of the war were aimed at economizing on personnel and simplifying the organization and can be disregarded here.

The rapid establishment of reliable technical signal communications in the course of military operations presupposes that the field commanders will inform the responsible office of the strategic intentions, points of main effort and planned order of events at the right time. Only in this way is it possible to take measures in advance which will shorten the time required for establishing signal communications as much as possible and which will be adapted to the special unit of the operation and theaters of war concerned. This includes the preparation of personnel and matériel, as well as, under certain circumstances, special training of the signal troops and officers who participate in the operation and selection of the appropriate technical devices. The terrain, the distances to be considered in the course of the operation, and the condition of the local signal communications in the zone of operations in question may play a decisive part in this connection. Thus, for example, during the French campaign it was possible to utilize the existing French overhead lines and cable network. The campaign in the East, on the other hand, with its tremendous distances over a country where communications were little developed, made it necessary to create and prepare strong signal units for the Army High Command for the purpose of establishing new communications, as well as to employ hitherto unknown technical devices for which the signal troops and their commanders first had to be given detailed training. The German Army High Command gave proper consideration to the above-mentioned problems by having the CHIEF OF ARMY SIGNAL COMMUNICATIONS and his staff attached to the Army General Staff from the very beginning, in contrast to the Chief of the Field Telegraph System at the beginning of World War I; and in all situations during World War II he worked in the immediate vicinity of the Army General Staff and of the Operations Branch in the headquarters of the Army High Command. The Chief of Army Signal Communications regularly attended the daily situation conferences of the Chief of Staff. In addition to that, the Chief of Staff himself or the Operations Branch gave him detailed information about their strategic intentions at an early date. This was also especially necessary because the plans for securing the necessary personnel and matériel for new operations first had to be submitted by the CHIEF OF ARMY SIGNAL COMMUNICATIONS to the home offices of the Army High Command in the ZI, the CHIEF OF ARMY EQUIPMENT AND THE COM-

MANDER OF THE REPLACEMENT ARMY.

Co-operation with the other branches of the Army General Staff, especially the Organizational Branch, Training Branch, Quartermaster General and Chief of Transportation, was carried out through close personal contact with the Branch Chiefs and respective specialists and generally with their direct personal agreement. Especially close was the liaison between the CHIEF OF ARMY SIGNAL COMMUNICATIONS and the ORGANIZATIONAL BRANCH, which had to find a proper place within the framework of the overall planning for the changing and increasing demands of the Signal Corps with respect to personnel and materiel. The Eastern and Western Foreign Armies Branches assigned tasks to the Control Station for Signal Intelligence, which compiled the results of its monitoring activities and gave them to the former as intercept situation reports. Liaison with the arms generals (General of the Infantry in the OKH, etc.) was maintained by special liaison officers. Here co-operation particularly covered the development of signal equipment for the communication units, especially radio sets, as well as training problems and assistance in preparing service manuals.

Among the other agencies of the Army High Command (see Appendix 3) the CHIEF OF ARMY SIGNAL COMMUNICATIONS had to co-operate principally with the CHIEF OF ARMY EQUIPMENT AND COMMANDER OF THE REPLACEMENT ARMY and his subordinate offices: the INSPECTOR OF THE SIGNAL CORPS, the SIGNAL COMMUNICATIONS GROUP (Amtsgruppe Nachrichtenwesen), the ORDNANCE OFFICE (Waffenamt) and the ORDNANCE INSPECTORATE (Feldzeuginspektion). This co-operation chiefly covered problems connected with the preparation of personnel and materiel for the signal troops of the field forces, MANDER OF THE REPLACEMENT ARMY.

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In the PERSONNEL OFFICE the SIGNAL CORPS was represented by two specialists. In connection with the important matter of filling the leading positions in the ARMY SIGNAL CORPS the CHIEF OF ARMY SIGNAL COMMUNICATIONS exercised his influence after personal consultation with the CHIEF OF THE PERSONNEL OFFICE or his deputy. At first there was no demand for a systematic, large-scale, long-range personnel policy aimed at giving men with special technical and tactical qualifications individual assignments and advanced training at an early date, and later this demand could not be fulfilled.

Co-operation with the respective agencies of other Armed Forces branches, the GENERAL SIGNAL OFFICER OF THE AIR FORCE and BRANCH 5 OF THE NAVAL COMMAND, was very loose. The air signal troops had their own, highly remified cable network between their headquarters and ground organizations, which was supplemented by radio and a network of permanent microwave communication lines. In addition to this it had an extensive radar organization. The very high demands of the Air Force for raw materials and signal equipment, which often exceeded the bounds of existing possibilities and thereby threatened to injure the rightful interests of the other Armed Forces branches, especially the Army, sometimes led to considerable friction. This was all the harder to eliminate because the Commander in Chief of the Air Force knew how to take advantage of his outstanding position with Hitler to put through his demands in favor of his own branch of the Armed Forces. In the Navy the special duties connected with the direction of sea-going units, submarine warfare and coast defense required a special kind of communication system, expert personnel and in part even special equipment. Attempts by the various branches of the Armed Forces to use their networks mutually were successful only in exceptional cases.

The incorporation of army signal communications within the framework of the Supreme Armed Forces command by the Armed Forces High Command was due to the fact that the CHIEF OF ARMY SIGNAL COMMUNICATIONS was CHIEF OF ARMED FORCES SIGNAL COMMUNICATIONS (See Appendix 4) in personal union and as such also belonged to the Armed Forces Operations Staff. In spite of all the disadvantages of this personal union when it came to representing matters affecting the Armed Forces as a whole as against the Air Force and Navy, it had the tremendous advantage that, without being affected by the dualism between the General Staff and the Armed Forces Operations Staff, the signal troops and signal communications of the Army could be uniformly employed. Besides that, his third personal union as Plenipotentiary General for Technical Signal Devices * enabled him to prepare an adequate amount of signal equipment at the right time which could be used as a stockpile for all the communications systems of all Armed Forces branches during almost the entire war.

Naturally, the co-operation of the specialists of the Chief of Army

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* In the Four Year Plan. (Author's note)

Signal Communications was especially close with the branches of the Armed Forces Signal Communications Group, which was under the Chief of Armed Forces Signal Communications. This group worked in Berlin on the ministerial tasks of the signal corps within the framework of the OKW. It combined all fields of signal communication which were common to all three branches of the Armed Forces and for this purpose was staffed with personnel taken from all branches of the Armed Forces. Together with the Military Communication Branch (Kriegsfernmeldeabteilung) the group was responsible for co-operation with the German Post Office and for the utilization of the postal telephone network **, especially the trunk wires, by the Armed Forces. The Radio Branch (Abteilung Funkwesen) had the same task with respect to radio communication. It was responsible above all for the difficult problem of selecting wave lengths and allocating frequencies and call signals to the three branches of the Armed Forces and other offices which were permitted to use radio communication, likewise the use of broadcasting stations for the work of the Air Force. In addition, it was in charge of radio counterintelligence, i.e., the monitoring of radio traffic between enemy agents. The Cryptographic Branch (Abteilung Chiffrierwesen) prepared our own codes and ciphers and solved what foreign ones were intercepted. The international diplomatic radio traffic was monitored by specialists for 28 nationalities in order to make this information useful to the war effort. This was distributed to interested offices as reliable information. Intercepts from enemy and neutral broadcasting stations were sent to the specialists as code intelligence

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** The German telephone and telegraph systems were administered by the Post Office, or Reichspost. (Translator's note)

(Chi-Nachrichten).

The subsequently formed branch of the Plenipotentiary General for Technical Signal Devices collected and decided on the wishes of the three Armed Forces branches with respect to the development of signal equipment. It collected applications from the Armed Forces branches and all other consumers, stating the signal equipment required by them, and forwarded these requests to the Main Committee for Electrical Engineering of the Ministry for Armament and War Production, after giving due attention to allocations of raw material, which it first had to justify before the Central Planning Board (zentrale Planung). The Main Committee for Electrical Engineering finally decided on the allocation of production.

The Armed Forces Signal Group had branch offices in the form of Armed Forces Signal Headquarters at most administrative offices of the German Post Office.

Co-operation between the Chief of Army Signal Communications and agencies outside of the Armed Forces was almost exclusively effected via the Armed Forces Signal Group in the OKW. As already mentioned, this applies chiefly to the especially important co-operation with the Reich Postal Ministry over which he had no command authority. Contrary to the minister's opinion that the Army's strategic communications could be established and operated better by the technically more competent organization of the German Post Office than by soldiers, the Chief of Army Signal Communications solved his problems during the war with the aid of his troops. In this connection the opportunity given him to utilize the technical installations and personnel of the Post Office proved of outstanding assistance. This applies both to German territory, where the most important through-connections had to be switched onto the valuable trunk-wire network, as well as to the utilization of the communication facilities of the occupied territories and the establishment and maintenance of all wire communications with the aid of Post Office specialists.

III. Implementation of the Duties of the Army Signal Communications System by the Signal Corps

The general rule for the employment of signal troops and the organization of signal communications was directly the opposite of what it had been at the beginning of World War I, namely, that the superior headquarters always had to establish communication with its subordinates. Wire communications constituted the foundation for the signal network, which was established and operated from the Army High Command down to the regiments by the signal troops, and from there to the companies and batteries and their most advanced elements by the unit communication formations. It was to be made possible to reach important headquarters and staffs over several lines in different ways. Their number was determined with due regard to the possibilities of multiple transmission according to the number of telephone and teletype messages which experience had shown were necessary for the business of command, supply and transportation. It was a general rule that every wire communication line had to be supplemented by radio. In the case of communications which could only be established and maintained by radio, especially in the armored units, the staffs and units in question were supplied with such a large number of radio sets, as well as wave lengths and traffic channels, that one could depend on reliable communications.

The organization of the Army Signal Corps was built up according to these service rules. At the beginning of the war the operational signal troops (Fuehrungsnachrichtentruppen), who were directly subordinate to the Chief of Army Signal Communications for the purpose of communicating between the Army High Command and the army groups, consisted of one, later two, operational signal regiments. They organized communication systems at the headquarters of the OKH and the Fuehrer's field headquarters and operated message centers there for the OKW and the Army, at first utilizing the trunk-wire network of the German Post Office for their long-distance messages. In the campaign against Russia the Chief of Army Signal Communications had one operational signal regiment behind each army group. They had to set up and maintain the continuous transposed open-wire system (Drehkreuzachsen) for communication between the OKH and the army groups, of which mention will be made later. Toward the end of the war there were eight operational signal regiments, consisting of operating and construction battalions with companies for the operation of telephones, radios, radio-teletypes, carrier frequency equipment, and long-distance telephone exchanges, as well as for the construction of telegraph and field-trunk lines. In order to insure uniform attention to their purely military interests, such as disciplinary power, replacement and training, they were combined under the Commander of the Operational Signal Troops, while they received their service orders directly from the Chief of Army Signal

Communications. Upon mobilization, army group and army signal regiments were organized out of a few companies which had existed in peacetime as cadres, in order to establish communication between army groups, armies and armored armies. Generally, such a regiment consisted of one operating battalion and two construction battalions, the former of which had two telephone operating companies, one each for the operations section and the supply and administration branch (Oberquartiermeisterabteilung), and one radio company, while the latter were organized each in one operating and three field trunk wire or telegraph construction companies. The regiments were controlled by the respective army group or army signal officer and were required to establish communications between the army groups and its armies or between the army and its corps. Just as was the case in peacetime, corps and division had their own signal battalions for communicating with their divisions or regiments. At corps level they consisted of one telephone operating company, one radio company and one to two field trunk-wire companies, at division level of one telephone and one radio company. The commanders of these battalions were at the same time the signal officers of their respective headquarters. The signal regiments and battalions, as well as the signal officers, were subordinate to their superior headquarters, the army groups, armies, corps and divisions.

Conditions in the field of signal communications were extraordinarily complicated in the so-called "Armed Forces theaters of war", which were directly under the Armed Forces High Command, i.e. those theaters of war of the Army which were handled by the Armed Forces Operations Staff. These were Norway, Finland, the Balkans, Italy and, after 1942, France. Up to the autumn of 1944 their communications were handled by the Armed Forces Signal Group. The first strategic communications during combat were established here between the German trunk-wire network and the high commands of the army groups and armies by the signal regiments of the armies and army groups, as well as the operational signal regiments. When operations came to a standstill, the operational signal regiments were withdrawn from the occupied territories. In connection with the control of signal communications in these areas the ministerial functions of the Armed Forces Signal Group of the OKW now became mixed up with the command duties of the Armed Forces Operations Staff, and still more confused conditions were created because units of the Commander of the Replacement Army, who had no operational signal troops of his own, were entrusted with the operation of strategic signal communications. This was true above all in Berlin, which was the most important junction for all wire and wireless communications. At the headquarters of the military commanders the local signal communications were improved and operated by SENIOR SIGNAL OFFICERS with the aid of Armed Forces and field signal commands, small operating and technical signal units, together with the postal authorities of the occupied territories, and these communication systems then became permanent.

As long as no mobile warfare was waged, this territorial framework was sufficient, but when the fronts in France, Italy and the Balkans became fluid in 1944, it was evident that the organization was too weak and cumbersome to cope with the requirements of combat and movement and it was then fundamentally altered. In the autumn of 1944 the above-mentioned fragmentary units and formations from formerly occupied territories, which were now available for new assignments, were reorganized into operational signal regiments behind all Armed Forces theaters of war (with the exception of Norway and Finland) in the West, Italy and the Balkans. These operational signal regiments were to provide communication between the Armed Forces Operations Staff and the army groups and after a brief period of adjustment they proved fully successful. The operational communications within Germany, which previously had been handled by units of the replacement army, were likewise transferred to the operational signal troops. Here at least this resulted in the following clear scheme of organization toward the end of the war: The Chief of Army Signal Communications and his staff handled the signal communications of the supreme ground forces command, as well as signal intelligence in all theaters of war, the work being performed by the operational signal troops, while the Armed Forces Signal Group restricted itself to all the administrative duties for the three branches of the Armed Forces.

The organization for carrying out "signal intelligence", which was the second most important task of the Chief of Army Signal Communications will be discussed separately.

During the war it proved necessary to organize a RAILWAY SIGNAL CORPS. Its duties were to operate the telephone, teletype and radio communications of the Armed Forces Transportation Chief and his branch offices, to establish and maintain signal communications for the railroad lines which had been repaired, built and operated by the field railway troops, and finally to repair and eliminate interference both on these lines and, toward the end of the war, numerous signal communication lines of the Reichsbahn, in co-operation with the latter. The Railway Signal Corps belonged to the Operational Signal Corps.

The "Fortress Signal Corps" worked in the fortifications of the West Wall, the Atlantic Wall, in the coastal defenses, in Norway and in the fortifications in the East. Within the fortification works themselves - at the West Wall and later at the Atlantic Wall from the frontmost lines back to the divisions - it constructed and operated fortress telephone networks, as well as radio and microwave communications, which met all reasonable demands, even during the heaviest fighting. In World War II carrier pigeons were no longer used to any appreciable extent to supplement the signal communications at fortified fronts. It was the same with messenger dogs, which the Signal Corps retained up to the end of the war as service dogs but employed for other purposes, e.g., as guard dogs and watch dogs.

At the beginning of the war the strength of the Army Signal Corps amounted to about 100,000 men in the field and 28,000 men in the replacement army, or roughly three percent of the overall strength of the Army, while at the time of its greatest expansion it comprised around 220,000 men. As the result of casualties and many men being transferred to the infantry it was around 180,000 men at the beginning of 1945, of which number the Operational Signal Corps under the Chief of Army Signal Communications had about 30,000 men.

In order to release men for frontline duty the Army Women Signal Auxiliary Corps (Nachrichtenhelferinnen) was organized in 1940 and by 1944 its strength was brought up to about 12,000 women. In spite of the necessity for strict organization, a great deal of consideration was nevertheless given to the natural needs of women from the very beginning. Their supervision and care while off duty was completely in the hands of older and experienced service-women. When they were employed in the zone of operations and in occupied countries it was a basic rule that women signal auxiliaries under no circumstances should be exposed to the direct effects of combat or the possibility of capture. In this way it was possible to restrict casualties among the women signal auxiliaries to a few unavoidable individual cases. Just like the male soldiers with the yellow service color * these German women worked tirelessly and unselfishly up to the last day of the war and performed their duties

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* Lemon yellow was the distinctive color of the German signal troops. (Translator's note).

as telephone, teletype and radio operators in an oustanding way.

The work of training signal troops was shared by the Chief of Army Signal Communications and the Commander of the Replacement Army with his appropriate agencies, the Signal Group and the Inspector of the Signal Corps. The Chief of Army Signal Communications restricted himself to the training of the signal troops of the field forces, which was given in army group and army signal schools, as well as in special courses held in the combat schools or signal units of the divisions and corps. The signal troops of the Replacement Army were trained in signal replacement and training battalions under the supervision of the Signal Group or the Inspector of the Signal Corps (cf. Appendix 3). Likewise under the Signal Group were Army Signal School with the Signal Instruction Regiment in Halle, and Army Signal School II in Glatz. Besides courses for the signal units of the Replacement Army, courses were given in Halle for company commanders, battalion and regiment commanders of the Signal Corps and unit communication officers of the field forces. Besides this, brief indoctrination courses were also given to familiarize regimental commanders from all service arms, members of divisional commander courses, as well as assistant chiefs of staff at the War College with the command system, duties and technical aspects of the Signal Corps. The Chief of Army Signal Communications could exert decisive influence on the arrangement of these courses. Army Signal School II trained candidates for the position of radio operator with all service arms and technical civilian employees (Signal Corps). There was a special school for Army Women Signal Auxiliaries. The training of officer replacements was given at the officer candidate school of the Signal Corps in Leipzig, which was under the INSPECTOR GENERAL FOR OFFICER CANDIDATES, whereas the technical training in signal communications was supervised by Army Signal School I in Halle. Part of the non-commissioned officer candidates were trained at the non-commissioned officer school of the Signal Corps in Zerbst, which was under the Chief of Army Equipment and Commander of the Replacement Army. In order to direct the training along uniform lines the Chief of Army Signal Communications prepared two periodical publications, the SIGNAL COMMUNICATION INFORMATION (Fernmeldemitteilungen), which was more of a technical nature, and the SIGNAL COMMUNICATION OF ALL SERVICE ARMS (Nachrichtenverbindungen aller Waffen), which discussed general problems concerning signal communications. All manuals concerning signal communications were approved by the Chief of Army Signal Communications and published by the Service Manual Office under him. The training of the unit communication formations of the Replacement Army (infantry, artillery, etc.), which was given in corresponding training companies and batteries, was supervised by the Inspector of the Signal Corps, insofar as the purely technical aspects of signal communications were concerned. In the field forces the training of unit communication formations was given in the signal schools or the divisional signal battalions.

The Most Important Means of Signal Communication and Their Technical Improvement

As had been the case in World War I, this war also led to an improvement in signal devices which often far exceeded the normal rate of technical progress. It was often very difficult, if not impossible, to find a place for current inventions and improvements and make them useful for the troops in view of the limited possibilities offered by our available raw materials and industrial capacity. Even by the end of the war, therefore, numerous improvements of tested military utility had not been introduced.

In the field of wire communications the previously mentioned four-wire field trunk cable had already been developed before the war. With this cable it was possible to transmit several telephone and teletype messages over a considerably greater distance than could be covered with the one-wire field cable. The most notable innovation, however, was the adoption by the Army Signal units of the carrier frequency technique of continuous transposed open-wire systems (Drehkreuzachsen). These were military bare-wire lines, with two wires, which were twisted from pole to pole - not alternately crossed as before. With the addition of carrier frequency equipment they were almost completely free of damping and theoretically made it possible to communicate over any desired distance. With the aid of carrier frequency and telegraphic equipment using alternating current the continuous transposed open-wire system became a "multiple-channel" line, i.e. it could be used for the simultaneous transmission of a large number of telephone and teletype messages. Among the equipment of this kind the MEK 8 (multiple single-channel system with eight channels), MG 15 (multiple group system with 15 channels), as well as the W T 6 and 12 (telegraphic equipment using alternating current with 6 or 12 channels) were developed and introduced in 1941. In this way it was possible to have 8 or 15 telephone channels and 6 or 12 teletype channels on one continuous transposed open-wire system, so that two wires could be used for 25 circuits. The subsequent development of double continuous transposed open-wire systems with four wires gave over 40 circuits. A line of this kind, for example, ran from Oslo to Narvik - Petsamo - Rovaniemi - Helsinki. With the addition of the marine cable from Oslo (Arensberg) to Jutland and from Helsinki to Reval it was possible to have reliable and extremely clear telephone communication from the Reich to the armies in Norway and Finland over a distance of from two to three thousand kilometers. Several of the most important lines were replaced in 1942 by the sturdier and more efficient U-cables (Styroflex - broad-band cables).

Apart from the introduction of non-damping portable switchboards and the above-mentioned carrier frequency and alternating current telegraphic adjuncts, the telephone apparatus had remained the same. Mobile repeaters rendered especially good service in connection with the re-establishment of cable communications in the occupied territories and later in Germany, where they had to replace the permanent repeater stations which had been destroyed by enemy air raids.

The trunk-wire network of the German Post Office, which was expanded between 1937 and 1939, was used almost exclusively for establishing wire communications in Germany for troop concentrations and build-ups for the various campaigns. This provided a sound foundation for the continuous transposed open-wire systems which the operational signal regiments extended from the German frontier into the combat sectors of the army groups, or, as in the French campaign in 1940, the corresponding wire communications utilizing the overhead line network and trunk wires in the occupied territories. The above-mentioned systems were expanded by means of technically similar local circuits into a wide-meshed, long-range wire network, the Army Basic and Operational Network, which was used for traffic through transit telephone centrals at the most important junctions. This network formed the central system from which all other wire communications radiated: the bare-wire network of the army groups and armies, the field trunk wire lines of armies and corps, finally the trunk wire lines of corps, divisions and unit communication formation. All these telephone communications were supplemented down to divisional level by teletype communications and the two systems were used together for innumerable daily messages from higher to lower and lower to higher headquarters, as well as between headquarters on the same level.

At the Army High Command and the Fuehrer's field headquarters the various branches of the Army General Staff and the Armed Forces Operations Staff held thousands of telephone conversations every day with the staffs and other agencies of all army groups and armies, as well as with the numerous government offices in Berlin. For this purpose many thousands of teletype, radio-teletype and radio messages had to be handled daily. Over a fairly long period of time the central teletype office of the Armed Forces Transportation Chief alone received and transmitted an average of 8000 messages a day. The specialists for enemy intelligence received the analyses of thousands of intercepted enemy radio messages every day by wire. Over long periods of time in World War II these two activities furnished the Army High Command with a perfect picture of every German unit and every enemy unit at the front, enabling it to issue commands which covered each and every detail. Admittedly, the Supreme Command made too extensive use of this opportunity during the latter phases of the war. Whereas in former wars, and even during the first campaigns of World War II, operations were conducted according to the time-tested rules of command by means of long-range directives which left a large degree of independence to the commanders in chief, the intensive and smoothly functioning signal network later led more and more to what was often an intolerable restriction of the independence of the subordinate commanders, to the withholding of responsibility and to an excessive preoccupation with pedantic details.

Tracts of country where it was impossible to lay bare-wire or cable lines were bridged by beam communications (Richtverbindungen), that is to say, beamed microwave radio messages. Such tracts might be rivers, swamps, enemy-occupied areas or zones threatened by guerrillas, as well as overseas communications, for example, to the islands of the Eastern Mediterranean and later in Holland. By using the proper equipment these circuits could also carry several telephone and teletype channels. In the establishment of permanent microwave beam communications and in technical developments the Airforce ground organization was ahead of the Army, which needed mobile equipment. After the first large-scale attempts in connection with preparations for the invasion of England (Operation "Seeloewe") in 1940, the medium microwave beam equipment with three telephone and one teletype channel, an 18-meter mast,with a range of about 32 kilometers, and the heavy microwave beam equipment with 10 telephone and teletype channels, a 30-meter mast and a range of about 45 kilometers, were used to achieve longer ranges in addition to the light microwave beam equipment with one telephone channel, which was intended to span short distances, such as at river passages. With this equipment it was possible at any time to establish connection with overhead continuous transposed open-wire systems and surface civil communication lines or cables. A prerequisite for all microwave beam communications, to be sure, was quasi-optical visibility between opposite stations. Apart from the height of the masts, this was accomplished with the aid of towers and stations on high mountains. One disadvantage was the possibility of interception, especially from aircraft. The success achieved with microwave beam communication had consequences of an organizational nature, in that plans were made to attach light microwave communication companies permanently to the army signal regiments and heavy companies to the army group signal regiments. Besides the important microwave lines in the partisan-infested zones of the Balkans and White Russia, the most important microwave communication system was the one established from Greece to Africa via Crete. In a few important cases one end station was elevated by means of a captive balloon.

For a long time a microwave communication system of this kind spanned a broad enemy-occupied zone from East Prussia to Courland, a distance of 250 kilometers, and after the destruction of the trunk-cable in the last days of the war, communications were maintained with encircled Berlin up to 29 April 1945 by means of a balloon communication system of this kind.

Insofar as telegraphic transmission was concerned, the development of wireless equipment progressed along the lines already mentioned. Here a number of different kinds of equipment were produced which worked on long, middle and short waves and were technically able to reach all the distances required. Difficulties with operational radio communications which arose during the campaigns in France, the Balkans and Russia were due less to technical defects than to an inadequate supply of heavy short-wave equipment. In view of the daily march distances and combat achievments of large armored units, the efficiency and range of the excellent 100-watt set were no longer sufficient to cover the distances between such units and they were supplied with too little heavy equipment. The short-wave sets first improvised for the still greater distances in Russia were unable to stand the mechanical strain of such tremendous marches and the short-wave personnel was still too inexperienced.

The Operational Signal Corps, the army group and army signal regiments, and the corps and division signal battalions had radio companies, which in many cases constituted the sole means of signal communication during the war of movement, where wire communications were not possible. As a protection against enemy interception it was strictly forbidden to transmit radio messages in clear, and as a precaution against enemy radio intelligence, strict attention was paid to radio discipline; operators worked in lines and networks, not in traffic areas, and messages were deciphered on general principles with a hand or mechanical cryptographic system. The frequently unreliable long-wave Morse communications with infantry and artillery aviation were followed after the Russian campaign by the ultra-short wave equipment, which provided a safe means of communication with the combat air reconnaissance. Here, as in radio communication in the front lines, code language was used. The problem of radio telephone communication between higher headquarters and staffs remained unsolved, since it was not possible to develop a perfect code language which would protect such conversations against the danger of interception.

Due to the impossibility of maintaining constant wire communications within infantry and artillery regiments in the actual combat zone, these units were equipped to a large extent with pack radio sets. Here, in the division signal battalions and unit communication formations, a number of sets were introduced which attained a high degree of perfection and were able to meet almost all the demands of the troops. In some respects these sets were unsatisfactory because of their excessive weight and the short life of the batteries. However, this was due less to defects in their mechanical construction than to the lack of suitable raw materials. The last word in this development were the field radio sets and portable radio sets, one-man sets which were attached to the belt, could be used in the frontmost lines and worked perfectly even when in movement.

Of particular importance was reliable radio communication between tanks and motorized units, and this applied not only to the troops in combat but also to communications between the staffs of the armored corps, armored and motorized divisions, and their regiments. As shown by successes in many different campaigns this problem of communication between tanks was solved admirably by means of ultra short-wave equipment. But the mobile radio detachments of the higher and intermediate command also obtained excellent results with their signal communication systems, which were never interrupted even during the longest and most rapid movements in France and Russia. Command was most flexible where the classic tank commanders, Guderian in France and Russia, Rommel in France and Africa, hurried from one point of main effort to another accompanied by their "general sections" (Generalstaffel), which were later imitated by many other commanders, and an armored radio section with a few tank radio operators, to command their armored divisions, armored corps and armored armies exclusively by radio from the foremost line.

During the subsequent course of the war radio-teletype equipment after 1943 assumed increased importance. This was mechanical radio communication with the aid of perforated-tape transmitters with a capacity of 25 letters per second. By using a so-called "G supplement" (G-secret) the messages were simultaneously enciphered or deciphered. 1000-watt long-wave and 800-watt short-wave transmitters were used. In view of the constantly increasing number of teletype machines this system constituted a valuable supplement to the wire network and relieved it of much of its traffic. With respect to organization it was planned to attach a radio-teletype company to the army groups' signal regiments. Admittedly, it was possible during this war to take full advantage of the efficiency of radio-teletype equipment only in communications to distant theaters of war, especially the Balkans, the Mediterranean islands, Italy, Courland, Norway and Finland.

Toward the end of the war all the communication facilities were greatly overloaded as the result of the loss of aircraft, motor vehicle and railroad courier services due to lack of fuel and the effects of enemy air raids, since many orders and reports which had formerly been sent in writing via courier channels now had to be forwarded as teletype, radio or radio-teletype messages.

Besides the establishment of communications, the second main task of the signal troops was signal intelligence. This consisted in the study of enemy message traffic, especially the mistakes and peculiarities of radio traffic. The results of these observations furnished the German command with valuable information of a tactical and strategic nature concerning the enemy and his intentions. As the result of the almost complete disappearance of ai reconnaissance during the positional phase and especially during the last two years of the war, signal intelligence often constituted the only useful means of reconnaissance. The signal intelligence units were organized accordingly. Close-reconnaissance signal units were incorporated in the signal battalions with the divisions, which chiefly monitored enemy radio traffic and in individual cases also telephone traffic with the assistance of intercept teams. They supplied the combat commanders with excellent information about the enemy which could be utilized immediately to increase the effectiveness of artillery fire. Attached to the corps signal battalions were auxiliary analysis sections which were able to solve the simplest kinds of ciphers. Signal intelligence commanders with one analysis section, as well as several signal intelligence battalions, each having one long-distance reconnaissance and one close-reconnaissance company, were placed under the signal officers of army groups. In general, one battalion of this kind was assigned to each area of an army, with which it was ordered to co-operate. In the Control Station for Signal Intelligence, later General of Signal Intelligence, of the Chief of Army Signal Communications important information for the supreme command was compiled and forwarded to the branches of Foreign Armies East and West. The Control Station for Signal Intelligence also had special units available to intercept special radio traffic, determine points of main effort and supplement the signal intelligence units of the army groups. In view of the increasing importance of signal intelligence to the war effort the office of the GENERAL OF SIGNAL INTELLIGENCE was created in 1944 in order to increase still further the efficiency of the signal intelligence units under the various army groups. The principal duty of the General of Signal Intelligence was to guarantee co-operation between the various signal intelligence units and the rapid exchange of the latest practical information, as well as to bring about a constant improvement in signal intelligence by exerting his influence on training, the selection of personnel and the development of equipment.

The information obtained by radio intelligence was of three kinds: first, message analysis, which was simple if the messages were transmitted by radio in clear and which, if they were transmitted by telegraph, gave varying results according to the difficulty of the cipher system used; second, traffic analysis, which independently of the content of the messages permitted valuable conclusion to be drawn from the volume and pattern of the traffic concerning the relative position of units in the chain of command and the formation of points of main effort; third, direction analysis, which with varying technical success enabled one to determine the location of staffs. This work was done almost exclusively according to the "direction-finding team procedure" (Kommandopeilverfahren), i.e. the direction-finders, which were situated at a distance and moved through a wide field, were guided by transmitters at the central receiving station which began operating as soon as the search receiver picked up enemy messages. In view of its repercussions on enemy signal intelligence this particular form of radio communication required special supervision and secrecy.

In keeping with the trend of technical developments toward short-wave communication, it was necessary to supplement the available intercept and position-finding receivers in order to pick up all frequencies and messages which were being transmitted. To this radio signal intelligence equipment, which was still of a simple kind, were added the extensive and complicated equipment for receiving enemy communications sent by means of mechanical transmitters, telephoto transmitters (Bildsender) and speach-scrambling machines, which were monitored and analyzed by the Cryptographic Branch of the Armed Forces Signal Communications Group and the Experimental Equipment Branch of the Ordnance Office.

The Air Force and Navy operated their own radio intelligence systems, which were adapted to their own special tasks. The latter co-operated with

Army Signal Intelligence without the mediation of the Armed Forces Signal Group.

Codes and ciphers and the cryptanalysis service will be described later.

Radio counterintelligence, i.e.,the observation and detection by long-range position-finders of transmitters used by enemy agents, was carried out by the Radio Branch of the Armed Forces Signal Communications Group in co-operation with the regular police in the Reich and the occupied territories and by Army and Air Force units in the frontline zone. To some extent notable results were achieved here. However, because of the lack of personnel and equipment, it was not possible to detect all the messages transmitted by enemy agents in Germany proper. It was also often difficult to get the necessary number of men ready in time to surround and apprehend enemy agents.

Especially successful was the development of radio monitoring, i.e. the monitoring of the radio traffic of our own troops, especially the mobile units during offensive operations, by higher headquarters with the aid of numerous receivers. In this way the higher command was continuously informed of the state of operations, especially about objectives which had been reached, and could make decisions at an early hour without having to depend on the time-consuming reports transmitted through official channels. The rapid adjustment to each new situation and the immediate exploitation of favorable situations which played such a large part in the successful course of our offensive operations were partly the result of the information furnished by these operations.

The work of selected specialists in the cryptanalysis service also provided solutions to numerous enemy cipher systems. Military ciphers of a simple kind were processed and solved in the analysis offices of the signal intelligence branches and the commanders of signal intelligence, while more advanced systems were solved at the Control Station for Signal Intelligence. The still more complicated systems used in diplomatic communications were tackled and in many cases likewise solved in the Cryptographic Branch of the Armed Forces Signal Group. Unfortunately, there was also a wasteful struggle for power in the field of cryptanalysis, with all the various offices concealing their results from each other. This was the case between the Armed Forces branches and at times even between such different Army organizations as the Cryptographic Branch, Radio Intelligence and the Signal Intelligence Group. Although this competition to some extent had a stimulating effect, the organization of the Army was nevertheless combined and simplified in a uniform way in 1944 without diminishing its ultimate effectiveness.

The clear and long-standing realization that it was possible to intercept all wireless and teletype communications made it necessary to develop cryptographic systems of our own which would be difficult to solve, although such systems were inconsistent with the Army's requirements of simplicity and rapidity, especially in the mobile units. Accordingly, the systems had to be arranged in varying degrees of security and the troops had to be content to achieve only temporary secrecy with their field ciphers and code languages. For operational messages the cipher machine was used and when it was realized that such messages could also be broken it was improved. In order to guarantee automatic security for teletype and radio-teletype messages the scrambling device (Geheimzusatz) was created, which after 1942 probably provided absolute security against decipherment. Our own systems were constantly checked by cryptanalysts working in separate units. Toward the end of the war the necessity of establishing the highest possible requirements in this connection was also impressed on other organizations outside the Armed Forces. By the end of the war the problem of scrambling messages in order to protect telephone and radio messages from enemy interception had been theoretically solved and a start made at the construction of such devices after all the enemy systems observed up to that time had been deciphered.

The supplying of the field forces, as well as the signal troops and the unit communication formations, with signal equipment was regulated by the Chief of Army Signal Communications in co-operation with the corresponding agencies of the OKW and the Chief of Army Equipment. The technical development of army signal equipment was handled by the Signal Branch of the Army Ordnance Office (Waffenamt Pruefwesen 7). The Army's requirements in signal equipment were met by the Signal Group of the Chief of Army Equipment and Commander of the Replacement Army (Chef H. Ruest, BdE). This branch had executive authority over the wire facilities of all branches of the Armed Forces. After processing by the Plenipotentiary General for Technical Signal Devices of the Armed Forces Signal Group, who had to co-ordinate the requests of the Armed Forces branches and other consumers, the signal equipment was procured by the Signal Equipment Branch (Waffen und Geraet 7) of the Ordnance Office. After its procurement and removal the equipment was later forwarded through supply channels by the signal equipment offices under the Ordnance Inspectorate. In the army groups and armies the signal officers handled the work of supplying their units and the troops with signal equipment independently of the quartermaster organization. Up to the summer of 1944 there had been no appreciable lack of vital signal equipment throughout the war. Production and technical progress had been able to meet all reasonable requirements in the various theaters of war. The production figures increased steadily until well into the autumn of that year. Then the factories in France, Belgium and Holland, in which many thousands of families in the occupied territories had earned their bread, were lost. At the same time there were very heavy losses of equipment among the troops in the East and West, as well as decreases in production due to the transfer of the electrical industry to Germany, this industry being located chiefly in the areas of Berlin, the Rhineland and Saxony, which were especially exposed to enemy air raids. The work of supplying the troops with field wire and field trunk wire, as well as portable radio sets, suffered particularly from these raids. The influence of the Chief of Army Signal Communications on the different signal equipment offices of the Army was only partially effective and was accompanied by much waste motion. During the last few months it was proposed to combine all offices concerned with the development, production, procurement, removal and supply of signal equipment into one Electrical Engineering Office, but it was no longer possible to carry out this plan.

The replacement of Signal Corps officers was handled by the Army Personnel Office. Enlisted men replacements were inducted and trained in the signal replacement and training battalions, which were subordinate to the deputy corps headquarters and, at higher level, to the Chief of Army Equipment and Commander of the Replacement Army. No appreciable difficulties arose in the field of replacement. This was due chiefly to the fact that Signal Corps casualties in men killed and wounded generally remained within tolerable bounds. It was not until toward the end of the war, when the Signal Corps had to release numerous personnel, especially the younger men, to the infantry, that a certain amount of tension arose.

IV. Signal Communications in the Different Theaters of War in Mobile and Position Warfare

It remained for the various campaigns of World War II to reveal whether the general rules worked out in peacetime for the commitment and use of signal communication facilities, the training of signal troops and the technical efficiency of signal equipment would meet the requirements of modern warfare. In addition, the Signal Corps command had to prove whether it was able to adapt the signal communication system smoothly to the strategic plans of the supreme army command and quickly recognize and take advantage of any new possibilities offered by applied science.

The mobile warfare of the campaigns in Poland and France confirmed in actual combat the possibility of commanding armored units in movement both tactically and strategically by radio alone. The field trunk cable lines kept pace with all armies, even armored armies, in advances of sometimes 100 or 150 kilometers a day. The permanent field-telephone lines of the signal units of the higher command were a failure, as could have been expected. Their poles, which carried eight bare-wire lines, lacked the necessary symmetry for multiple use. Due to lack of familiarity with the transposition systems in Belgium and France, attempts to make quick repairs on the overhead lines which were found there were only partly successful. On the other hand, we were successful, contrary to expectations, in making the French trunk-line network, which was disrupted in many places, serviceable for a few important military connections within a very short while. Radio communications, especially among the trained tank radio operators, worked better than had ever been expected in peacetime. In another respect they left something to be desired, since the constantly increasing distances between armies and corps exceeded the maximum ranges of, for example, the 100-watt standard set. Signal intelligence achieved hardly any results in Poland, since the Polish radio network broke down after the second day of the campaign. During the French campaign really amazing strategic information was obtained, such as the complete French troop concentration behind the Weygand Line.

New suggestions were furnished by the campaign in Norway. Trunk lines were lacking in this rocky country with its scanty communications, whereas the bare-wire line systems were excellently developed and in many cases used for multiple-channel communication with the aid of carrier frequency equipment.

The Balkans are so mountainous and rich in metals that the campaign there resulted in radio failures with the old long and medium wave sets, which were too weak, and the new short-wave equipment, which was too sensitive. No great distances were involved as yet which had to be covered by telephone, so that it was sufficient to construct field trunk lines and repair the existing overhead lines, some of which had been erected by German telegraphers in World War I. Later, the improved form of microwave transmission was the most important system of communication in areas endangered by partisans and in the islands of the Eastern Mediterranean.

The practical experience gained during four campaigns had led to the clear realization that quickly erected military bare-wire lines could only meet the mechanical and electrical requirements of multiple-channel communication if two wires were used. By 1942 the development and production of carrier-frequency equipment had progressed so far that it was possible to begin experiments, and subsequently actual training, on a large scale. Then, during the Russian campaign, this technique became the outstanding success of our strategic communication systems in Russia, a country which was likewise without telephone lines. One operational signal regiment in each army group sector established a continuous transposed open-wire system behind the field trunk-wire lines of the armies from the German border, starting from the German trunk-line network which had been extended from the Galician border to Lithuania before the beginning of the campaign. With the aid of the corresponding local circuits this resulted in the above-mentioned, wide-meshed communication network upon which all the other wire communication systems were based. With few exceptions it was thus possible for the Army High Command to maintain regular telephone and teletype communication with each army group and army and to satisfy the requirement of the supreme command that it be informed daily concerning the movements of every division. This East front network, which was many thousands of kilometers long, met every demand made upon it for over three years up to the evacuation of the occupied territories. After 1942, perfected and efficient microwave signal equipment, for example, in the Caucasus and in the partisan-infested areas of White Russia, proved a valuable supplement to the wire communication system. After initial failures with the new radio equipment, technical research as well as production advanced so far that they could meet all requirements made in Russia even with respect to ranges. From the beginning of the campaign radio intelligence scored more and more successes on the

Eastern front, first on the strategic level and then to an increasing extent on the tactical level, and with the growth of enemy superiority and the elimination of air reconnaissance, this information became of increasing importance for the command.

In the African campaign it was again the radio system of the motorized units which, along with the field trunk-wire lines, gave outstanding performance. In contrast to the careless British, Rommel's radio intelligence functioned with exemplary efficiency until the intelligence company and its records were captured at El Alamein and the enemy changed his systems.

Signal communications in the various theaters of war in the second half of 1944 can be appraised as follows:

Finland and Norway: Both after and before this time there was a perfectly functioning signal network via wire, radio and radio-teletype.

France: Before and during the 1944-invasion fighting the French trunk-wire network, which had been extended from 6000 to 11,000 kilometers by German matériel and German labor during the four years of the occupation, was hard hit by enemy air raids and the sabotage of resistance groups. Although it was supplemented by several bare-wire secondary channels it lacked a less vulnerable and more easily repairable complementary wire network. The system of eliminating wire interference in conjunction with the French postal authorities was a makeshift expedient which favored acts of sabotage. When the higher command authorities had to abandon the headquarters which they had occupied for years, the fact that the command and the weak, insufficiently motorized signal troops were unaccustomed to co-operating with each other in mobile warfare led to difficulties which had a detrimental effect on the command. Thus, for example, for a long time during this period the communication facilities between the Armed Forces Operations Staff and Commander in Chief West and Army Group G were inadequate. Radio communications, which were likewise inadequate, although they had been adopted before the invasion, did not provide a satisfactory substitute. Even the signal intelligence was too weak and cumbersome. At the front the enemy, with his tremendous superiority in materiel had only been able to destroy our tactical signal communications by means of pattern bombing. Thanks to the self-sacrificing efforts of the maintenance men the telephone communications from the frontmost line to the divisions were repaired again and again. The same was true in the case of the tactical radio communications. Close-range radio intelligence scored special successes in Normandy against enemy radio traffic, supplying the combat commanders with excellent information about the enemy, which could be immediately used to increase firing accuracy. After the retreat behind the West Wall the signal units, which were already too weak, became even weaker as a result of losses in men and materiel, and for a long time their communications between the Rhine and the Western front were inadequate. The units had to be reorganized and reinforced. The Commander in Chief West and his army groups and armies were provided with signal regiments. Radio intelligence in the West was also reorganized and reinforced.

Italy: Conditions were similar here as the result of the enemy's superiority in materiel at the front, his air superiority in the hinterland and the intensive activity of the partisans. The troops mastered these difficulties in the same way as they had done in France. Toward the rear the slower course of the rear movements and the dense trunk-wire network in Northern Italy favored operational communications. There we succeeded in spanning the Po plain, which was especially threatened, and four Alpine passes with a large-scale wire network at the right time, and expanded this with cross-communications so intensively that workable signal communications were available.

The Balkans: Here too there were no trunk wires available. Both before and after this time it was difficult to maintain the broad-meshed, bare-wire network in mountainous country and it was full of gaps as the result of constant cutting by partisans. The expedient of using wireless communications, especially the numerous good microwave communications, failed to make up for these losses.

Russia: The wire network, which had existed for three years and had been constantly improved, was still largely intact, although to a large extent it was exposed to interruptions by partisans in many places, for example, behind Army Group Center. At the front the network was closely meshed, in the occupied territories toward the rear as far as the German border it very widely meshed. The wire communications were supplemented by radio.

The signal intelligence system was very carefully organized both strategically and tactically and was a very valuable source of information about the enemy for the specialists at headquarters. As the result of the loss of wide areas in the East in the summer and fall of 1944 the above-mentioned close-meshed wire network was lost. Numerous new lines had to be constructed.

In Germany the continuous heavy air raids after 1944 had seriously damaged the German trunk-wire network. In the environs of the big cities there were numerous breakdowns in the four-wire cable system. Moreover, in many cities extensive technical installations were destroyed. Maintenance crews of the

Armed Forces and the German Post Office worked with the greatest self-sacrifice to repair this damage. In spite of their efforts, communications on the West front became worse. The postal telephone network in the ZI was less flexible in operation and so hard hit by air raids with respect to personnel and matériel that it was able to meet the additional demands of the war effort only to an inadequate extent. Added to this was the simultaneous increase in the demands made on the postal network due to the relocation and subdivision of government authorities, for industrial purposes, as well as for the Party, which had been entrusted with duties of national defense.

The situation led to the decision to transfer the continuous transposed open-wire system, which with the aid of carrier frequency equipment could be used for multiple-channel communication and had proved so successful in the East, to behind the new fronts in order to supplement the trunk-wire network. In the few months before the end of the war the operational signal regiments erected about 15,000 kilometers of continuous transposed open-wire systems between north and south, and east and west, a valuable new network which was almost entirely enclosed in the interior of the Reich and worked splendidly up to the last days of the war. In this way it was possible to construct the most important communication systems of the supreme army command on a priority basis with comparatively little material. This new network was first used to span the Rhineland, which was threatened with bombing, then the Alpine passes in the south, the area around Salzburg and Munich being circumvented, while Budapest in Hungary, and later Pressburg and Vienna, were eliminated. The new network covered Silesia, West and East Prussia, the coastal area of the Baltic and North Seas; it surrounded Berlin and traversed the last, narrow land-bridge between North and South Germany.

V. Brief Critical Appraisal of the Structure, Organization and Working Methods of the Signal Communications System of the German Army in World War II

Signal communications are the nervous system of an army. They conduct the ideas originating in the brain of the supreme command to the fist, the fighting troops, where the ideas are converted into action. The structure of the signal communications system of an Armed Forces, therefore, is to a great extent dependent on the structure of the supreme command itself. Accordingly, a study of the structure of the signal communications system really should be preceded by an appraisal of the top-level military organization of the German Armed Forces. This is not the task of the present treatise. However, it must be said, that the structure of the German top-level military organization was dependent on personalities and their mutual struggles for power and was therefore very confused. It gave rise to a great deal of friction even in the field of signal communications. Here too this resulted in conditions which were again dependent on other personalities and difficult to understand clearly. However, the work involved should have called for the most efficient possible use of personnel and matériel in the organization and construction of communication systems and the joint utilization of the available networks according to the importance of the various users. For this purpose uniform, centralized direction was of an importance which cannot be overestimated. Theoretically an office of this kind existed in the form of the Chief of Armed Forces Signal Communications in the OKW. However, since the position of the OKW was very weak, not only within the Armed Forces itself but also in its relations with the government offices outside of the Armed Forces, for example, the Reichspost, it was impossible for the office of the Chief of Armed Forces Signal Communications to prove fully effective in the field of signal communications. Neither in this position nor as Plenipotentiary General for Signal Communications did he have any authority to issue orders to the signal chiefs of the other branches of the Armed Forces, but was forced to depend on their co-operation. The numerous successes scored against the stronger forces on the outside in spite of this were due solely to his powers of persuasion and his diplomatic skill. It was only with respect to the Army that the influence of the Chief of Armed Forces Signal Communications was fully effective, since he was Chief of Army Signal Communications in personal union at the same time. Conditions became particularly difficult and confused when the OKW no longer limited itself to the duties of the overall war effort but also assumed direct command with the Armed Forces Operations Staff in certain theaters of war. Despite the fact that the Signal Chief belonged to the General Staff and the Armed Forces Operations Staff, this inevitably resulted in considerable friction and overlapping of authority, as previously described in this work. It was not until the end of 1944 that this intolerable situation was fundamentally altered. But even within the Army the signal communications system failed to achieve any clear-cut form of organization. Thus, the influence of the Chief of Army Signal Communications on the Signal Group and the corresponding branches of the Ordnance Office of the Chief of Army Equipment and Commander of the Replacement Army was only partially effective. On the other hand, however, the activity of the Signal Group with respect to replacement, training and the supplying of signal equipment was of the greatest importance for the field forces. Here in particular there was constant friction, which could certainly have been avoided to a large extent in any clear-cut organization.

The fact that all the confusion described above did not result in grievous disadvantages for the Army High Command, but that on the contrary there were outstanding successes to be noted in all fields of its extensive activities, was due to the outstanding personality of the Chief of Army Signal Communications, General der Nachrichtentruppe Fellgiebel. Even in peacetime, as chief of staff of the inspectorate and as Inspector of the Signal Corps he already had exercised a decisive influence for a number of years on the Army's signal communications system and the development of the Signal Corps and signal equipment from its small beginnings. Mention should be made here once again of the services he rendered in developing the German trunk-wire network, which was one of the cornerstones of the successes achieved by German signal communications. While occupying a leading position as Chief of Army Signal Communications and Chief of Armed Forces Signal Communications during the war he had at an early date recognized and directed all the changes in the structure of the Signal Corps and its physical equipment which resulted from the changes in the structure of the strategic command and the various conditions in the different theaters of war. Despite the many disadvantages of this personal union, he also knew how to exploit its advantages and employ his instrument with consummate mastery. As Plenipotentiary General for Technical Signal Devices, Fellgiebel had at his disposal the only perfectly functioning Armed Forces organization, on which his influence was that of a co-ordinator and equalizer. Another special service rendered by him was the "Fellgiebel project", the creation of additional raw materials by reclaiming dismantled and used material. It was so successful, for example, that there was always sufficient copper available even up to the end of the war. A large number of his more important assistants had likewise served for years in leading positions of the Army Signal Corps in both peace and war. The personnel disadvantages which this procedure involved, and which were in part considerable, cannot be discussed in any greater detail here. In practice, its most important result was that the organization of the executive branch of the Signal Corps was to a large extent adapted to the personal idiosyncrasis of the leading personalities instead of giving exclusive consideration to the requirements of the work.

Toward the end of 1944 the preliminary work which was intended to bring about a basic simplification and uniform direction of signal communications within the Army, as well as in the relation between the OKW and the Army, had been concluded. In its full implications this work never found expression in any practical results. Nevertheless, it should be briefly described here as one possibility for a clear and understandable solution of this problem.

It was planned to create a GENERAL OF THE SIGNAL CORPS IN THE OKW AND OKH who in a uniform way would direct the ministerial duties of the OKW through the Armed Forces Signal Group, all questions of signal communications in all land theaters of war through the former staff of the Chief of Army Signal Communications, and in his capacity as Arms Inspector, all questions of the Signal Corps replacement system through the Signal Group of the Commander of the Replacement Army. At the same time, as already mentioned, all offices in any way concerned with questions of signal equipment, e.g., the Plenipotentiary

General for Technical Signal Devices, the Signal Equipment Branch (Nachrichtengeraeteabteilung) of the Signal Group, the Signal Branch (WA Pruefw.7), the Signal Equipment Branch (W.u.G. 7), the ordnance offices, were to be combined into one ELECTRICAL ENGINEERING OFFICE (Amt Elektrotechnik) under the Chief of Armed Forces Equipment, in which the General of the Signal Corps in the OKW and OKH would be assured a decisive influence. Even then the relationship with the Air Force and Navy still remained unclarified, a problem which, in view of the peculiar nature of the positions of the commanders in chief in question, could not be clearly solved for the time being.

VI. Final Words

The extension of the theaters of war in World War II to the boundaries of Europe and Africa confronted the German Signal Corps with tremendous and constantly increasing problems which it had never contemplated in peacetime. To a great extent it continued to solve them up to the last days of the war and thus enabled the supreme army command to carry out rapid, positive and large-scale operations. The difficulties presented during the last turbulent weeks of the war can be disregarded in this appraisal. The absolute devotion to duty and excellent basic training of this small corps, as well as its rapid utilization of new technical discoveries and immediate exploitation of the experience gained in so many different theaters of war for the benefit of organization, training and equipment, were the foundations for the huge, highly efficient signal networks which spanned the distant theaters of war and brought them closer to the command as well as to each other. From small beginnings the signal intelligence system had developed into an indispensable instrument of both the tactical and strategic command.

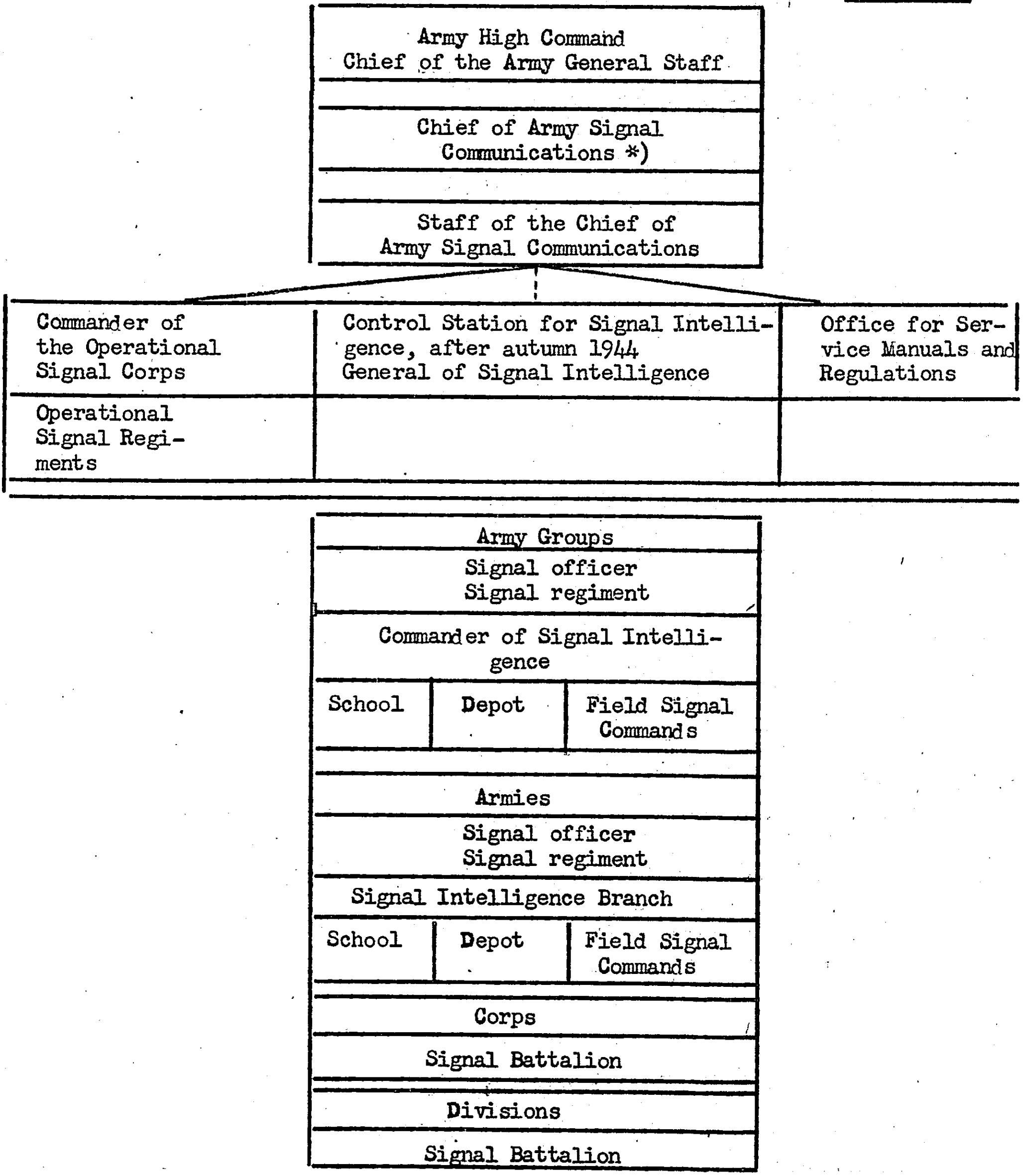
True to their oath of allegiance, many thousands of officers, noncommissioned officers and enlisted men of the Signal Corps, like their comrades in the other service arms, sacrificed their lives and health in the sincere belief that they were fighting for a just cause.

In the negotiations for the surrender in Rheims, prospects were held out that the still intact signal regiments would be used to repair the destroyed German communications network. With the material still available their experienced specialists would have been able to carry out this task in a few months during 1945 and thereby establish the basic conditions for public order and administration, to unite dispersed families and to provide the defeated nation with work, food, housing, warmth and peace. The promise was not kept.

signed: Albert Praun

General of the Signal Corps
from 13.8.44 to 15.5.45 Chief
of Army Signal Communications
in the OKH and Chief of Armed
Forces Signal Communications
in the OKW

Appendix 1



Army High Command
Chief of the Army General Staff

Chief of Army Signal Communications *)

Staff of the Chief of Army Signal Communications

Commander of the Operational Signal Corps	Control Station for Signal Intelligence, after autumn 1944 General of Signal Intelligence	Office for Service Manuals and Regulations
Operational Signal Regiments		

Army Groups
Signal officer
Signal regiment
Commander of Signal Intelligence

School	Depot	Field Signal Commands

Armies
Signal officer
Signal regiment
Signal Intelligence Branch

School	Depot	Field Signal Commands

Corps
Signal Battalion

Divisions
Signal Battalion

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*) Chief of Armed Forces Signal Communications in personal union (See Appendix 4)

signed: Albert Praun

Appendix 2

Staff of the Chief of Army Signal Communications

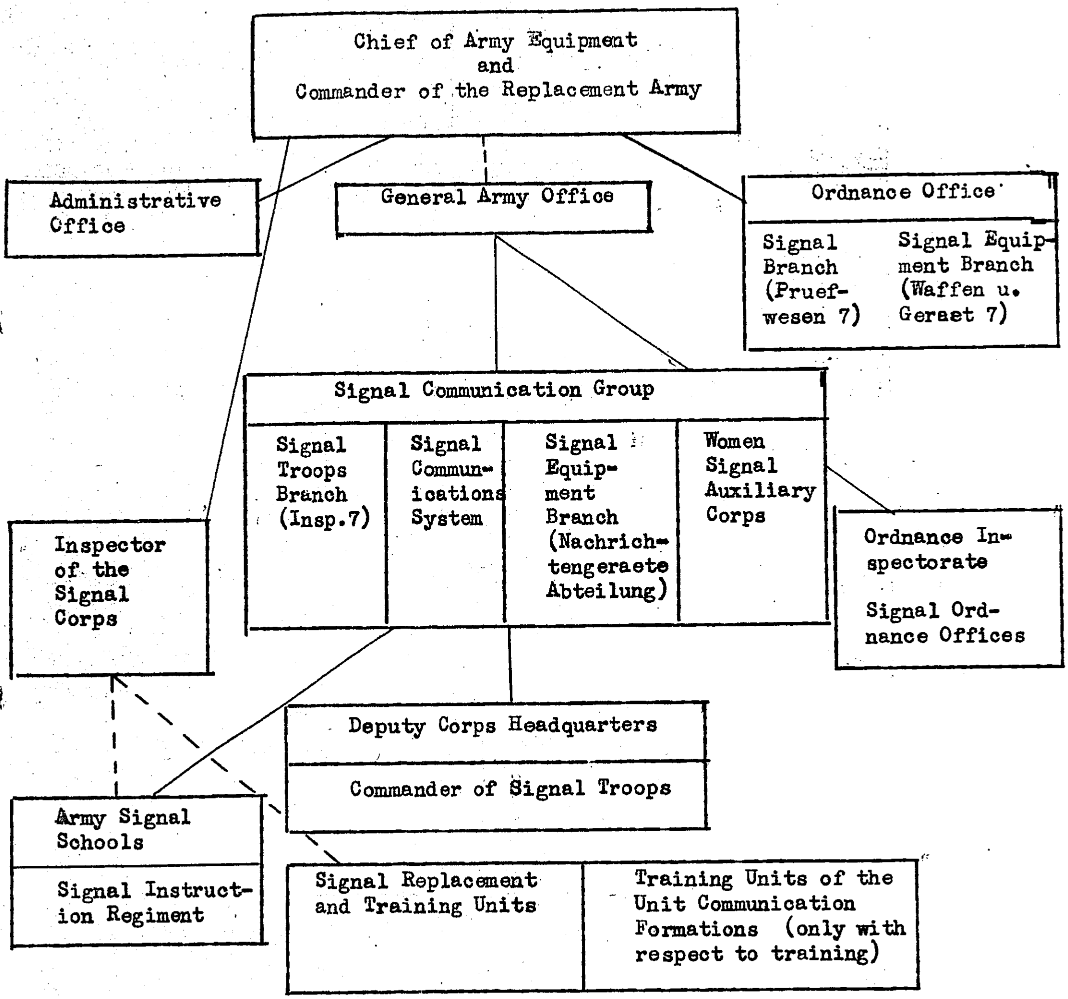
Chief of Staff

Section Z (Central Section) Handles personnel matters Commandant of Staff Headquarters	Section I Commitment Organization Training	Section II Signal equipment	Section III Telephone, teletype and microwave communications

Section IV Radio and radio-teletype communications	Section V Railway signal communications	Section VI Control Station for Signal Intelligence	

signed: Albert Praun

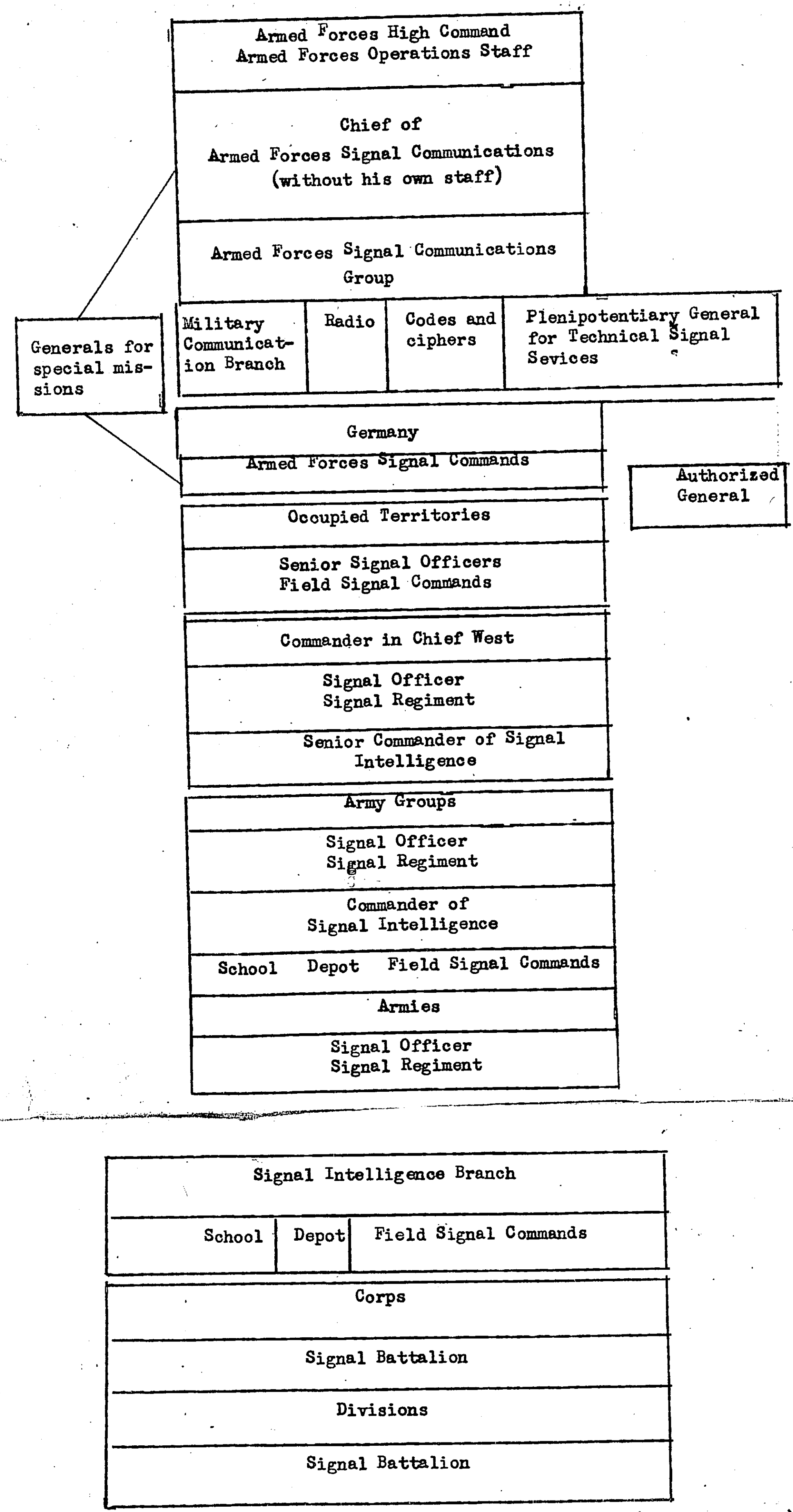
Appendix 3


Chief of Army Equipment and Commander of the Replacement Army
Administrative Office
General Army Office
Ordnance Office
Signal Branch (Pruefwesen 7)
Signal Equipment Branch (Waffen u. Geraet 7)
Signal Communication Group
Signal Troops Branch (Insp.7)
Signal Communications System
Signal Equipment Branch (Nachrichtengeraete Abteilung)
Women Signal Auxiliary Corps
Inspector of the Signal Corps
Ordnance Inspectorate
Signal Ordnance Offices
Deputy Corps Headquarters
Commander of Signal Troops
Army Signal Schools
Signal Instruction Regiment
Signal Replacement and Training Units
Training Units of the Unit Communication Formations (only with respect to training)

---------------- Subordinate only with respect to training

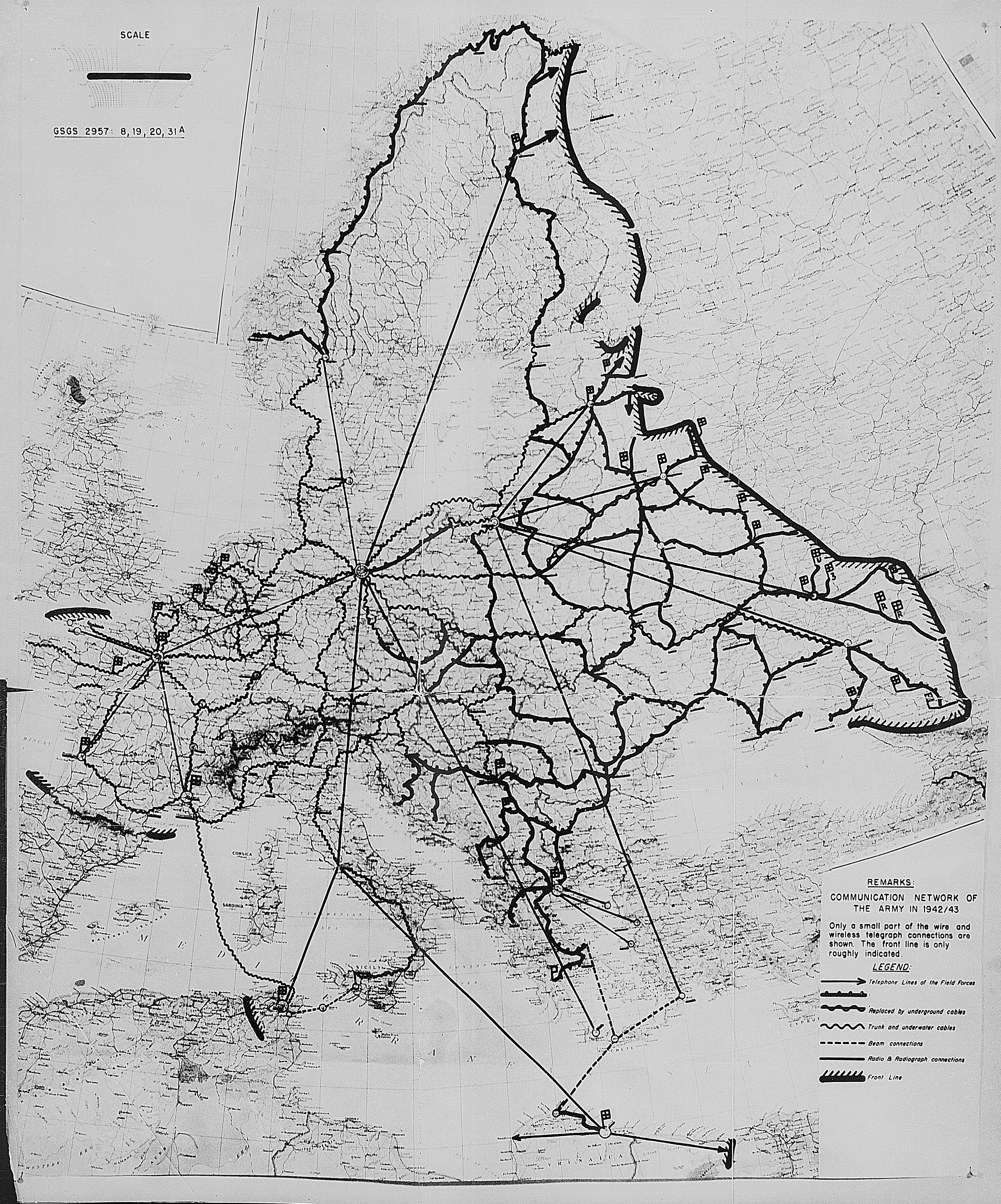
The following are not listed:
Variations in chain of command, railway and fortress signal troops, fragmentary units of various kinds.

signed: Albert Praun



Chief of Army Signal Communications in personal union (see Appendix 1).

signed: Albert Praun



SCALE
GSGS 2957: 8, 19, 20, 31A
CORSICA
SARDINIA
LEGEND:
Telephone Lines of the Field Forces
Replaced by underground cables
Trunk and underwater cables
Beam connections
Radio & Radiograph connections
Front Line

REMARKS:

COMMUNICATION NETWORK OF THE ARMY IN 1942/43

Only a small part of the wire and wireless telegraph connections are shown. The front line is only roughly indicated.